Translation of Japanese Unexamined Patent Application

BENDING RESTRICTION MEMBER FOR OPTICAL FIBRE

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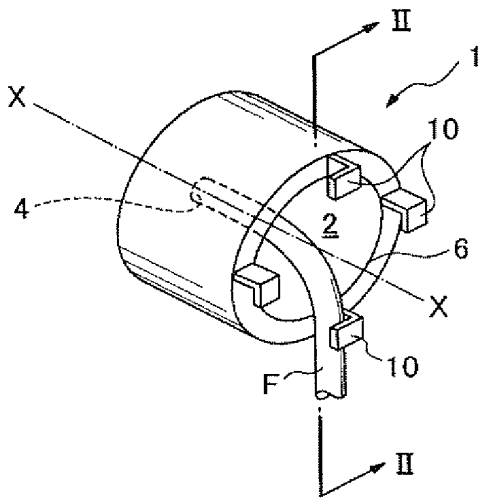
Abstract

TASK: To provide a bending restriction member for optical fibre which prevents an optical fibre being disposed with bending in excess of the permissible bending radius. [1]*

SOLUTION: The optical fibre bending restriction member 1 of the present invention restricts the bending radius of optical fibre ***F*** and comprises restriction part 8 [2] for restricting the bending of optical fibre ***F*** in a plurality of directions in such manner that it will not bend with a radius of curvature which is smaller than the permissible bending radius of that optical fibre.



Claims

1. A bending restriction member for optical fibre for restricting the bending radius of an optical fibre, said bending restriction member characterised in that:

it comprises a restriction part for restricting the bending of said optical fibre in a plurality of directions in such manner that it will not bend with a radius of curvature which is smaller than the permissible bending radius of that optical fibre.

2. The bending restriction member for optical fibre according to Claim 1, wherein said restriction part comprises a curved surface having a radius of curvature equal to or greater than said permissible bending radius.

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* Numbers in square brackets refer to Translator's Notes appended to the translation.

3. The bending restriction member for optical fibre according to Claim 2, wherein said curved surface is trumpet-shaped, this shape being obtained by rotating an arc with a radius of curvature equal to or greater than said permissible bending radius.

4. The bending restriction member for optical fibre according to Claim 2, wherein said curved surface comprises two curved surface parts separated by 180° and extending in opposite directions.

5. The bending restriction member for optical fibre according to any one of Claims 2 to 4 inclusive, wherein a hole of approximately equal diameter to the outer diameter of said optical fibre is provided at the base end of said curved surface.

6. The bending restriction member for optical fibre according to any one of Claims 2 to 5 inclusive, wherein a retaining part for retaining said optical fibre is provided at the front end of said curved surface.

7. The bending restriction member for optical fibre according to Claim 6, wherein a plurality of said retaining parts is provided.

8. The bending restriction member for optical fibre according to Claim 3, wherein a plurality of retaining parts for retaining said optical fibre is provided at the front end of said curved surface at approximately equiangular intervals.

9. The bending restriction member for optical fibre according to any one of Claims 6 to 8 inclusive, wherein said retaining part is a hook.

10. An optical fibre provision structure characterised in that:

the bending restriction part for optical fibre according to any one of Claims 1 to 9 inclusive is arranged on the outside of a wall of a building, and an optical fibre is provided through a through-hole formed in the wall, said through-hole communicating with said bending restriction member. [3]

11. The optical fibre provision structure according to Claim 10, wherein the end of the optical fibre that has been arranged through said through-hole is connected to a wall socket provided on the inside of the wall.

Detailed Description of the Invention

Technical field of the invention

(1) The present invention relates to a bending restriction member for optical fibre, and more particularly to a bending restriction member for preventing an optical fibre being laid with bending greater than a permissible value.*

Prior art

(2) When laying optical fibre, it is sometimes necessary for the fibre to be arranged with a bend. For example, when laying optical fibre inside a building, fibre that has been arranged in the space behind a wall is passed through a socket mounted on the wall and led out into a room. When this is done, the optical fibre, which in the space behind the wall extends roughly parallel to the wall, is bent by approximately 90° behind the wall socket so that it can head into the room.

Problem that the invention will solve

(3) When an optical fibre is arranged with a bend in this manner it sometimes ends up bending in excess of the permissible bending radius. In particular, when it bends in the space behind a wall in the above-described manner, the difficulty of working with the fibre itself contributes to the likelihood that the fibre will end up being bent in excess of the permissible bending radius. Bending of an optical fibre in excess of the permissible bending radius is to be avoided as it results in a deterioration of the transmission characteristics.

(4) The present invention has been devised in the light of this situation, and it is an object of the invention to provide a bending restriction member for optical fibre which prevents an optical fibre being disposed with bending in excess of the permissible bending radius.

Means for solving problem

(5) The present invention is a bending restriction member for restricting the bending radius of an optical fibre. The invention provides a bending restriction member for optical fibre comprising a restriction part for restricting the bending of the optical fibre in a plurality of directions in such manner that it will not bend with a radius of curvature which is smaller than the permissible bending radius of that optical fibre.

(6) Given this constitution of the invention, when an optical fibre is laid, it will not bend with a radius of curvature which is smaller than the permissible bending radius. Moreover, because the bending restriction operates in a plurality of directions, the invention has great versatility.

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* Numbers in round brackets at the beginning of paragraphs correspond to the paragraph numbering in the Japanese patent document.

(7) According to a preferred mode of the present invention, the above-mentioned restriction part comprises a curved surface having a radius of curvature equal to or greater than the above-mentioned permissible bending radius.

(8) According to another preferred mode of the present invention, the above-mentioned curved surface is trumpet-shaped, this shape being obtained by rotating an arc with a radius of curvature equal to or greater than the above-mentioned permissible bending radius. Giving this constitution, an optical fibre can be bent through 90° with a radius of curvature which is equal to or greater than its permissible bending radius, irrespective of the direction from which the fibre has arrived.

(9) According to another preferred mode of the present invention, the above-mentioned curved surface comprises two curved surface parts separated by 180° and extending in opposite directions.

(10) According to another preferred mode of the present invention, a hole of approximately equal diameter to the outer diameter of the above-mentioned optical fibre is provided at the base end of the above-mentioned curved surface. Given this constitution, an optical fibre can be fixed at the base end of the curved surface by being passed into the opening. [4]

(11) According to another preferred mode of the present invention, a retaining part for retaining the above-mentioned optical fibre is provided at the front end of the above-mentioned curved surface. Given this constitution, an optical fibre can be fixed at the front end of the curved surface by being retained by the retaining part.

(12) According to another preferred mode of the present invention, a plurality of the above-mentioned retaining parts is provided, and more preferably, these are provided at approximately equiangular intervals at the front end of the above-mentioned curved surface. It is also preferable for the retaining part to be a hook. Preferably, this hook is approximately L-shaped.

(13) According to another mode of the present invention, there is provided an optical fibre provision structure wherein any of the above-described bending restriction parts for optical fibre is arranged on the outside of a wall of a building, and an optical fibre is provided through a through-hole formed in the wall, the above-mentioned through-hole communicating with the above-mentioned bending restriction member. [5]

(14) According to a preferred mode of the present invention, the end of the optical fibre that has been arranged through the above-mentioned through-hole is connected to a wall socket provided on the inside of the wall.

Modes of practising the invention

(15) A bending restriction member for optical fibre according to modes of practising the present invention will now be described in conformity with the drawings. Firstly, the constitution of bending restriction member 1 of a first mode of practising the invention will be described with reference to FIG. 1 and FIG. 2, of which FIG. 1 is a perspective view of optical fibre bending restriction member 1 according to this first mode of practising the invention, and FIG. 2 is a sectional view defined by line II–II in FIG. 1.

(16) As shown in FIG. 1 and FIG. 2, bending restriction member 1 has an approximately round cylindrical external form. Internal space 2 is formed inside bending restriction member 1 and passes through it in an axial direction. At one end (the base end), this internal space 2 communicates with the space beyond restriction member 1 by means of hole 4 having an inner diameter approximately equal to the outer diameter of optical fibre ***F*** to be laid. At the other end (the front end), it communicates with the space beyond restriction member 1 via opening 6 having a diameter approximately equal to the outer diameter of restriction member 1. Hole 4 and opening 6 are connected by inwardly and convexly curving horn-shaped (i.e., trumpet- or funnel-shaped) curved surface 8. This curved surface 8 has a shape obtained by rotating an arc around centre axis X of bending restriction member 1, this arc having a radius of curvature equal to or greater than the permissible bending radius of optical fibre ***F*** that is to be laid. Consequently, the radius of curvature of this curved surface 8 is equal to or greater than the permissible bending radius of optical fibre ***F*** to be laid, with the result that an optical fibre ***F*** that has been laid along this curved surface 8 will not be bent at less then the permissible bending radius.

(17) A portion of any curve can be used as the arc that is rotated, provided that the portion of the arc having the smallest radius of curvature is equal to or greater than the permissible bending radius. For example, a portion of a variety of curves such as a circle, an ellipse, a parabola or a hyperbola can be used.

(18) In the present specification, "permissible bending radius" signifies for example the radius at which the increase in transmission loss as measured by the measuring method for attenuation of multimode optical fibres described in JIS C6823 is equal to or less than 0.5 dB/km. In this method, X metres of an optical fibre to be measured is set up between a light source at the transmitting end and an optical power meter at the receiving end. Firstly, the quantity of output light obtained is measured after the optical fibre has been cassette-wound with a winding diameter of 30 centimetres. This quantity is designated ***a***. Note that a driver is arranged between the light source and the optical fibre, and that cladding modes are removed from the light launched into the fibre to give a steady-state mode. Next, a portion of the optical fibre at a position

X/2 metres along the length of the fibre is formed into a single 90° bend with a bending radius R, and the quantity of output light measured. This quantity is designated ***b***. The permissible bending radius is defined as the bending radius at which $\boldsymbol{a}-\boldsymbol{b} = -0.5$ dB.

(19) Hook 10 is provided at the front end of bending restriction member 1. In the present mode of practising the invention, four hooks 10 are provided at intervals of 90° around the periphery of the front end of bending restriction member 1. Hook 10 is an approximately L-shaped member which extends perpendicularly from the front end face of bending restriction member 1 to a length that is approximately equal to the outer diameter of the optical fibre to be laid, and then bends by approximately 90° and extends roughly parallel to the front end face of bending restriction member 1. In other words, it is adapted to be capable of retaining an optical fibre between itself and the front end face of bending restriction member 1.

(20) In the present mode of practising the invention, bending restriction member 1 and hook 10 are integrally moulded from plastic or other synthetic resin. However, they may be separately moulded from plastic or other synthetic resin and then joined. Alternatively, they can be constructed from a material other than a synthetic resin, such as metal or ceramic.

(21) The bending restriction member of the present mode of embodying the invention is applicable to optical fibres such as silica fibre, polymer-clad fibre, fluorine resin plastic optical fibre and PMMA plastic optical fibre.

(22) An example of the use of bending restriction member 1 will now be described. As depicted in FIG. 3, bending restriction member 1 is for example arranged on the outside of wall ***W*** of a building to which optical fibre ***F*** is to be laid, in such manner that its base end faces the inside of a room. Note that in the example illustrated in FIG. 3, the hole of bending restriction member 1 [6] is formed obliquely to the axis of bending restriction member 1.

(23) Bending restriction member 1 is joined, via through-hole 12 formed in wall ***W***, to optical fibre wall socket 14 disposed on the inside of the wall. As a result, internal space 2 of bending restriction member 1 communicates, via through-hole 12, with the inside of wall socket 14. Optical fibre ***F*** that reaches bending restriction member 1 after extending through the space outside wall ***W*** passes through bending restriction member 1 which extends into through-hole 12, and reaches the inside of optical fibre wall socket 14, the front end of which has been disposed on the inside of wall ***W***. There it is joined to optical fibre ***f*** which is inside the room. Connection adapters 16 and 18 are respectively fitted to the end of optical fibre ***F*** (which extends outside the wall) and the end of optical fibre ***f*** laid inside the room, and optical fibres ***F*** and ***f*** are optically connected by joining these connection adapters 16 and 18.

(24) Optical fibre ***F*** that has passed through the space outside wall ***W*** is held between hook 10 and the front end face of bending restriction member 1; is bent through approximately 90° over curved surface 8; passes through hole 4; and extends into the optical fibre wall socket on the inside of wall ***W***.

(25) With bending restriction member 1 of this sort, optical fibre ***F*** is disposed along a curved surface with a radius of curvature equal to or greater than the permissible bending radius of the fibre, and therefore, at locations where it is disposed in this bent manner, the optical fibre is not bent with a radius of curvature smaller than the permissible bending radius. Furthermore, optical fibre ***F*** is retained by hole 4 and hook 10, and hence its laid position is maintained. It may be noted that the dimensions of wall socket 14 [7] are established so that optical fibre ***F*** extending into the wall socket from bending restriction member 1 curves in a path that is greater than its bending radius. [8]

(26) Next, the constitution of bending restriction member 20 according to a second mode of practising the present invention will be described with reference to FIG. 4. As shown in FIG. 4, bending restriction member 20 has an approximately cuboid external form. Space 22 penetrating through the interior is formed inside bending restriction member 20. At one end (the base end), this space 22 communicates with the space beyond restriction member 20 by means of hole 24 having an inner diameter approximately equal to the outer diameter of optical fibre ***F*** to be laid. At the other end (the front end), it communicates with the space beyond restriction member 20 via opening 26 which is approximately equal to the external form of restriction member 20.

(27) Hole 24 [9] and opening 26 are connected by two curved surfaces 28 and 30 which extend in opposite directions separated by 180° (in FIG. 4, they extend respectively upwards and downwards), these curved surfaces curving inwardly and convexly. Curved surfaces 28 and 30 have a radius of curvature equal to or greater than the permissible bending radius of optical fibre ***F*** to be laid. Consequently, an optical fibre ***F*** that has been laid along these curved surfaces 28 and 30 will not be bent at less than the permissible bending radius.

(28) The basic method of using bending restriction member 20 is the same as in the case of bending restriction member 1 of the first mode of practising the invention. Bending restriction member 20 differs from bending restriction member 1 in that the laying direction of optical fibre ***F*** is restricted to two directions separated by 180° — namely, a first direction indicated by the solid lines in FIG. 4, and a second direction indicated by the dash-and-two-dot lines.

(29) With bending restriction member 20 of this sort, optical fibre ***F*** is disposed along curved surface 28 or 30 having a radius of curvature equal to or greater than the

permissible bending radius of the fibre, and therefore with this bending restriction member as well, at locations where the optical fibre is disposed in this bent manner, it is not bent with a radius of curvature smaller than its permissible bending radius.

(30) The present invention is not restricted to the embodiments described above, and various alterations and modifications within the scope of the claims are feasible.

(31) Hooks of the sort provided by bending restriction member 1 of the first mode of practising the invention can also be provided on bending restriction member 20 of the above-described second mode of practising the invention.

(32) Although in the bending restriction members of the above-described embodiments a single optical fibre was disposed in bent manner, the present invention can also be adapted for disposing a plurality of optical fibres in bent manner. When adapted in this manner, the hole in the base end is formed with consideration of the outer diameter of the optical fibre bundle to be disposed.

(33) Moreover, although in the above-described embodiments the bending restriction was imposed by means of a curved surface, it is also feasible to impose the bending restriction by means of, for example, a step-form portion instead of a curved surface.

Effects of the invention

(34) As has been described above, the present invention provides a bending restriction member for optical fibre which prevents an optical fibre being disposed with bending in excess of the permissible bending radius.

Brief Description of the Drawings

FIG. 1 is a perspective view of an optical fibre bending restriction member according to a first mode of practising the present invention.

FIG. 2 is a sectional view defined by line II–II in FIG. 1.

FIG. 3 is a schematic sectional view showing the situation where a bending restriction member according to the first mode of practising the invention has been fitted to a wall.

FIG. 4 is a perspective view of an optical fibre bending restriction member according to a second mode of practising the present invention.

Explanation of referencing numerals

1 ····· bending restriction member

2 ····· internal space

4 ····· hole

6 ····· opening

8 ····· curved surface

FIG. 1

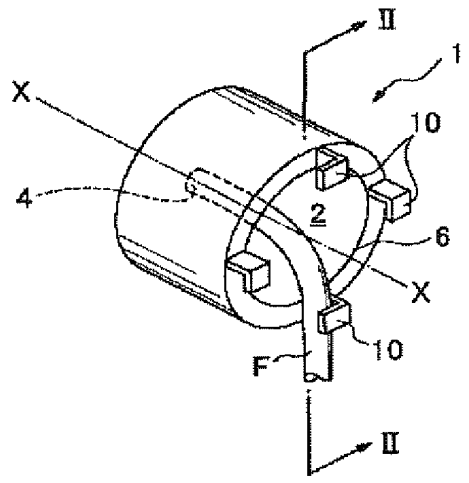


FIG. 2

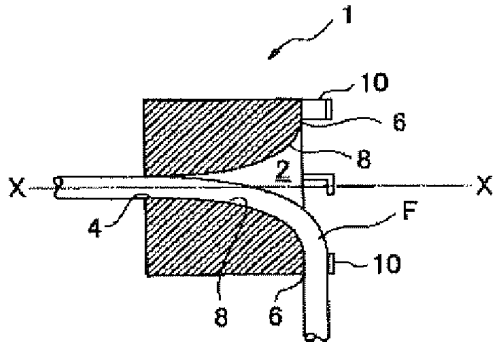


FIG. 3

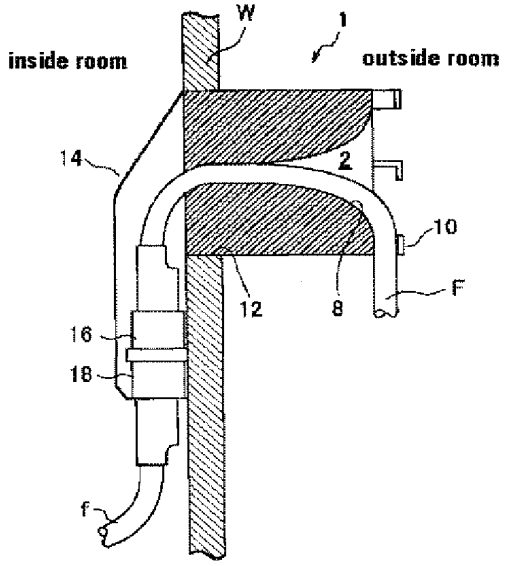
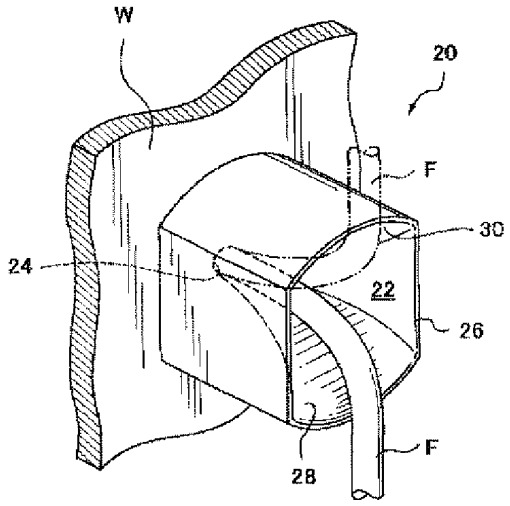


FIG. 4



TRANSLATOR'S NOTES

1. Sic. This is a possibly misleading expression. By "bending in excess of the permissible bending radius", the writer is presumably intending to signify "bending **more tightly than** the permissible bending radius".

2. The "restriction part" referenced 8 can be seen in FIG. 2. Essentially, the "restriction part" is a curved surface.

3. Sic. This seems an awkward way of describing what I take to be essentially the situation depicted in FIG. 3: namely, the bending restriction member of the invention is fitted into a through-hole in a wall, and therefore passing an optical fibre through the bending restriction member in effect passes the fibre through the through-hole in the wall.

4. Sic. This statement about fixing the fibre does not seem very precise. Is the implication that the hole at the base end of the curved surface can be used to fix the fibre in place?

5. See Note 3 above.

6. The writer is presumably referring to hole 4 (see FIG. 1 and FIG. 2) in the base end of the bending restriction member.

7. The Japanese text has "wall socket 12", a minor error which I have corrected in the translation.

8. Sic. This statement is not very precise. The writer presumably means that the wall socket dimensions are designed so that when connected, optical fibre ***F*** extending from the bending restriction member does not bend with a radius of curvature smaller than its permissible bending radius.

9. The Japanese text reads "hole 22". However, 22 references the internal space and I have therefore made the appropriate correction.